Section II (Remarks)

November 20, 2008 USPTO Interview

Appreciation is expressed to examiners Abul Kalam and Phat Cao for the courtesy extended to the undersigned attorney in granting the interview conducted with them at the USPTO on November 20, 2008.

Applicants hereby affirm the accuracy of the Interview Summary issued by examiner Phat Cao at the conclusion of the interview, as involving discussion of the October 20, 2008 Office Action and the then-pending claims. The grounds of rejection set out in the October 20, 2008 Office Action were maintained, but as noted in the Interview Summary, "Applicant may submit more evidence(s) to overcome the applied rejections." Such additional evidence is presented in this response.

Enclosed and submitted herewith is an Affidavit of George Brandes, presenting such further evidence in support of the patentability of the amended/added claims now pending in the application, as directed to a liquid crystal display comprising a back light structure including an LED/phosphor assembly in which the LED is energizable to emit radiation and the phosphor is arranged to be impinged by radiation from the LED so that the LED/phosphor assembly produces white light back light illumination for the liquid crystal display (independent claim 70, as amended herein).

Such additional evidence is submitted in affidavit form, as was requested by examiner Cao during the November 20, 2008 USPTO interview.

The affiant, George R. Brandes, holds a PhD degree in physics from Brandeis University, awarded in 1989, and was a Post-doctoral Member of Technical Staff at Bell Laboratories from 1990 to 1992. He is named as an author or co-author in numerous technical journal articles in the field of wide bandgap semiconductors. Dr. Brandes, as set out in his Affidavit, has performed research in wide bandgap semiconductors for approximately 18 years, and further managed or directed the research efforts of numerous other scientists in the same field. He is currently a

Director at Cree, Inc., which is a leading innovator and manufacturer of semiconductor materials and devices. Dr. Brandes is named as an inventor or co-inventor on a large number of U.S. patents, foreign patents, and patent application publications relating to wide bandgap materials, including wide bandgap material-based microelectronic devices and processes, for example, U.S. Patent Nos. 7,390,581; 7,282,744; 7,170,095; 7,118,813; 6,958,093; 6,680,489; 6,641,938; 6,596,079; 6,447,604; 6,329,088; 6,268,229; 6,031,250; 5,973,444; 5,900,301; 5,872,422; 5,680,008; and 5,608,283; and U.S. Patent Application Publication Nos. 20080265379; 20080199649; 20080112452; 20070018198; 20060152140; 20060228584; 20050167697; 20050104162; 20050009310; 20030213964; 20040222431; 20030178633; 20030157376; 20020096684; 20020068201; and 20020059898.

As attested in his affidavit, Dr. Brandes has read and is familiar with the present application, U.S. Patent Application No. 10/623,198, as well as the prior prosecution record of this present application, including the October 20, 2008 Office Action and the references cited therein. As further attested, Dr. Brandes also is familiar with the facts and circumstances surrounding the making by Bruce Baretz and Michael A. Tischler of the invention as now claimed in amended claim 70.

The Brandes affidavit attests to facts concerning the requirements of LCD backlighting, and facts evidencing the non-obviousness, at the time the claimed invention was made, of using white light emitting LED/phosphor assemblies for such purpose.

The Brandes affidavit also appends exhibits (information releases of Fraunhofer-Gesellschaft) evidencing the non-obviousness of LED/phosphor assemblies *per se*, for white light emission.

This affidavit evidence is discussed more fully hereinafter.

Independent claim 70 has been amended herein, as suggested by examiner Cao, to recite that the LED/phosphor assembly in the claimed liquid crystal display "produces white light back light illumination for the liquid crystal display."

Finally, U.S. Patent Nos. 4,573,766 and 5,143,433, copies of which were furnished by examiner Kalam to the undersigned attorney during the November 20, 2008 USPTO interview as additional background references, have been made of record in the present application by an Invention Disclosure Statement filed December 9, 2008.

Such additional references are addressed hereinafter in the discussion of the patentability of pending claims 31, 33-36, 44, 47-48, 51-52, 70-71 and 73-76.

Cancellation of Claims 32, 37-38, 43, 45-46, 49-50, and 72, Amendment of Claims 31, 33-36, 44, 47-48, 51-52, and 70-71, and Addition of New Claims 73-76

Claims 32, 37-38, 43, 45-46, 49-50 and 72 have been canceled herein, to advance the prosecution of the present application. Such cancellation of claims is with express reservation of the right to file further application(s) directed to the subject matter thereof, during the pendency of the present application, or during the pendency of a further divisional or continuation application based on and claiming the priority of the present application.

Claims 31, 33-36, 44, 47-48, 51-52, and 70-71 have been amended herein.

Claim 70 has been amended herein to introduce the term "white light" to characterize the back light illumination of the claimed liquid crystal display, as suggested by examiner Cao during the November 20, 2008 USPTO interview (see discussion, *supra*). Claim 70 as thus amended recites

> 70. A liquid crystal display comprising a back light structure including an LED/phosphor assembly in which the LED is energizable to emit radiation and the phosphor is arranged to be impinged by radiation from the LED so that the LED/phosphor assembly produces white light back light illumination for the liquid crystal display.

Claim 70 now constitutes the only independent claim in the application.

In connection with such amendment of claim 70 to recite "white light back light illumination," claim 72, formerly depending from claim 70 and reciting white light emission from the LED/phosphor assembly, as been canceled.

In claims 31, 33-36, 44, 47-48, 51-52, and 71 as amended, claims 31, 33-36, 44, 47-48, 51 and 71 depend directly from claim 70, and claim 52 depends indirectly from claim 70. All such claims 31, 33-36, 44, 47-48, 51-52, and 71 have been amended for consistency with independent claim 70, from which they now depend. In addition, claim 47 has been amended to recite phosphor material emitting radiation in at least the red spectrum, consistent with the disclosure at page 16, lines 20-21 of the application, discussing "red luminescent emissions" obtainable from phosphor material.

No new matter (35 USC 132) has been introduced by the amendments of claims 31, 33-36, 44, 47-48, 51-52 and 70-71.

New claims 73-76 have been introduced herein, to claim further aspects of the invention. Each of such newly added claims is directly or indirectly dependent on claim 70.

New claim 73 recites the liquid crystal display of claim 70 as "comprising a plurality of LED/phosphor assemblies arranged in a regular pattern array for white light back light illumination of the liquid crystal display," consistent with the disclosure at page 22, lines 9-12 of the specification ("white light emitting diode device assemblies ... arranged in an array comprising a regular pattern of such assemblies...for a back light illumination panel for a structure such as a liquid crystal display").

New claim 74 depends from claim 73 and recites that "individual LED/phosphor assemblies in said regular pattern array are selectively illuminable," consistent with the disclosure at page 22, lines 12-13 of the specification ("individual assemblies 10 may be selectively illuminated").

New claim 75 depends from claim 73 and recites that "LED/phosphor assemblies in said regular pattern array are controlled by a controller in response to user input," consistent with the disclosure at page 22, lines 16-17 of the specification ("selective illumination of the component

light emitting assemblies 10 of the Figure 4 display is suitably controlled by a controller 31 in response to user input").

New claim 76 depends from claim 73 and recites that "all LED/phosphor assemblies in said regular pattern array are arranged to be simultaneously illuminated," consistent with the disclosure at page 22, lines 20-22 of the specification ("all of the component light emitting assemblies 10 may be illuminated simultaneously for back lighting applications").

Accordingly, no new matter (35 USC 132) has been introduced by such added claims 73-76.

Claims 31, 33-36, 44, 47-48, 51-52, 70-71 and 73-76 are now the claims pending in the application.

Rejections of Previously Pending Claims 31-38, 43-52 and 70-72 on Reference Grounds

In the October 20, 2008 Office Action, claims 31-38, 43-52 and 70-72 then pending in the application were rejected on reference grounds, including:

- a rejection of previously pending claims 31-33, 35-38, 44-47 and 50-52 under 35 USC 103(a) as unpatentable over **Stevenson et al. US Patent 3,819,974** ("Stevenson") in view of **Silsby US Patent 5,563,621** ("Silsby");

- a rejection of previously pending claims 34 and 39 under 35 USC 103(a) as unpatentable over **Stevenson** and **Silsby** as applied to claims 31 and 44, further in view of **Kitagawa et al. US Patent 5,237,182** ("Kitagawa");

- a rejection of previously pending claims 43 and 48 under 35 USC 103(a) as unpatentable over **Stevenson** and **Silsby** as applied to claims 31 and 44, further in view of **alleged Applicants Admitted Prior Art** ("AAPA"); and

- a rejection of previously pending claims 70-72 under 35 USC 103(a) as unpatentable over **Seder US Patent 5,211,467** ("Seder") in view of **Stevenson**.

Such rejections are traversed in application to claims 31, 33-36, 44, 47-48, 51-52, 70-71 and 73-76, as amended/added herein. A discussion of the patentability of these claims follows.

Patentability of Claims 31, 33-36, 44, 47-48, 51-52, 70-71 and 73-76

The only one of the rejections made in the October 20, 2008 Office Action that remains pertinent to the newly amended/added claims is the rejection of previously pending claims 70-72 under 35 USC 103(a) as unpatentable over Seder in view of Stevenson, since:

- claim 70 is now the only independent claim pending in the application;
- claim 72 has been canceled; and
- all remaining pending claims 33-36, 44, 47-48, 51-52, 71 and 73-76 now depend directly or indirectly from claim 70.

In the October 20, 2008 Office Action, claims 70-72 were rejected under 35 USC 103(a) as unpatentable over Seder in view of Stevenson. Claim 72 has been canceled.

Claim 70, as amended herein, is set out below for ease of reference.

> 70. A liquid crystal display comprising a back light structure including an LED/phosphor assembly in which the LED is energizable to emit radiation and the phosphor is arranged to be impinged by radiation from the LED so that the LED/phosphor assembly produces white light back light illumination for the liquid crystal display.

Seder has been cited as teaching a liquid crystal display comprising a backlight structure including a lamp/phosphor assembly.

Seder discloses a fluorescent lamp, e.g., a mercury vapor lamp emitting at 254 nm, including a gas-filled glass or quartz tube (12) with no phosphors on the inside surface of the lamp. Reflectors direct radiation to phosphors (26) on an external phosphor diffuser plate (25), as shown in FIG. 1 of Seder (reproduced below), wherein (14) is a mirror and (24) is a bandpass reflector:

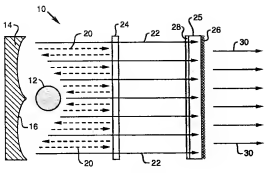


Figure 1

Seder also describes an arrangement shown in FIG. 2 of such reference (reproduced below), in which phosphor (42) is on mirror (44), and bandpass filter (48) transmits white light to a liquid crystal cell or display (60):

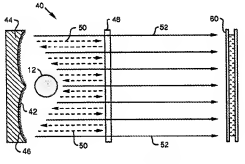
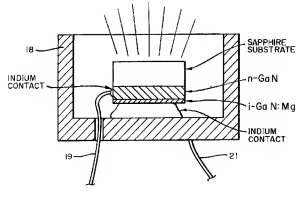


Figure 2

Stevenson discloses a gallium nitride LED producing violet light (column 1, lines 10-12 of Stevenson) that is emitted through a transparent substrate (sapphire), as shown in the single figure of such reference:



Stevenson in columns 3-4 discloses that:

> "... there has been provided an improved light emitting diode capable of emitting light in the violet region of the spectrum. This device may be used as a source of violet light for applications where this spectral range is appropriate. This light maybe converted to lower frequencies (lower energy) with good conversion efficiency using organic and inorganic phosphors. Such a conversion is appropriate to develop different colors for aesthetic purposes, but also to produce light in a spectral range of greater sensitivity for the human eye. By use of different phosphors, **all the primary colors may be developed** from this same basic device. An **array of such devices may be used for color display systems**; for example, a solid state TV screen."

Stevenson thereby teaches primary color generation by an LED/phosphor device, with an array of primary color devices being used for color display systems such as solid state TV screens.

In other words, Stevenson contemplates using a first LED/phosphor device for generating primary color red light, a second LED/phosphor device for generating primary color green light, and a third LED/phosphor device for generating primary color blue light, thereby generating all the primary colors (red, green and blue), and placing such primary color devices in RGB arrays for applications such as solid state TV screens.

The rejection of claims 70 and 71 is based on the contention that it

> "would have been obvious to substitute the lamp of Seder with the LED taught by Stevenson, because such a modification would have been considered a mere substitution of art recognized equivalents" (page 8, October 20, 2008 Office Action).

As discussed above, Stevenson discloses the use of an LED/phosphor device to generate a primary color, and use of an array of such primary color-generating LED/phosphor devices for color displays. The Stevenson teachings are consistent with the conventional approach in the display field at the time the invention was made, to use an LED emitting red color light, an LED emitting green color light and an LED emitting blue color light, to provide a red LED/green

LED/blue LED assembly, as a so-called RGB (red-green-blue) array.[1] Stevenson is concerned with primary color generation for displays, and does not contain any disclosure relating to back lighting, and does not disclose an LED emitting ultraviolet radiation. See also the accompanying Brandes affidavit, at paragraph 4 thereof.

Seder describes a fluorescent lamp, such as a mercury vapor lamp, emitting ultraviolet radiation at 254 nm, including a gas-filled glass or quartz tube with no phosphors on the inside surface of the lamp. See also the accompanying Brandes affidavit, at paragraph 5 thereof.

The proposal in the October 20, 2008 Office Action to substitute the LED taught by Stevenson for the lamp in the Seder arrangement requires one to disregard Stevenson's teaching to use an LED/phosphor device to generate a primary color, as well as to disregard Stevenson's teaching to use an array of such primary color-generating LED/phosphor devices for color displays. There is therefore no logical basis in the disclosures of the Stevenson and Seder references for their combination, and any attempt at such combination would require disregard of these express teachings in the Stevenson reference. See also the accompanying Brandes affidavit, at paragraph 7 thereof.

More specifically, the combination urged by the Office Action would require (i) arbitrary[2] extraction of the non-UV emitting LED from the apparatus taught by Stevenson, to the exclusion of all other components in such apparatus (ii) arbitrary extraction and discarding of the UV-emitting gas-filled tube from the Seder fluorescent lighting system, and (iii) insertion of the non-UV emitting LED of Stevenson into the Seder fluorescent lighting system, in place of the removed UV-emitting gas-filled tube of Seder.

It will therefore be apparent that the hypothetical modification of Seder by Stevenson being urged in the Office Action will result in a non-UV emitting LED in place of a UV-emitting gas-filled tube, thereby failing to provide the UV radiation taught as an essential feature of Seder for

[1] see, for example, the discussion at page 4, line 21 to page 5, line 2 of the present application, and Stinson U.S. Pat. No. 4,992,704 described therein.

[2] these steps are arbitrary because there is no basis in the references themselves for making such modification, and the "art recognized equivalents" hypothesis urged in the Office Action is incorrect, as shown in the ensuing remarks.

the illumination application disclosed in such reference. The hypothetically modified Seder system will as a result be inoperative for its intended purpose, since the essential UV light will be absent!

Thus, one of ordinary skill in the art would not logically view the UV-emitting gas-filled tube of Seder to be an "art recognized equivalent" of the non-UV emitting LED of Stevenson.

In addition, the primary color teachings of Stevenson for solid state TV screen applications do not integrate in any straightforward or apparent manner with the fluorescent tube backlighting teachings of Seder.

These facts further underscore the absence of any logical basis in Seder and Stevenson for applicants' claimed invention.

On such basis alone, claim 70, and claim 71 dependent thereunder, are patentably distinguished over the cited Seder and Stevenson references.

In addition to the foregoing grounds for patentability of claims 70 and 71, the accompanying Brandes affidavit presents further evidence of the non-obviousness of the invention claimed in amended claim 70 (reproduced below for ease of reference):

> 70. A liquid crystal display comprising a back light structure including an LED/phosphor assembly in which the LED is energizable to emit radiation and the phosphor is arranged to be impinged by radiation from the LED so that the LED/phosphor assembly produces white light back light illumination for the liquid crystal display.

As attested in paragraph 8 of the Brandes affidavit, at the time the invention of claim 70 was made, it was not known that an LED/phosphor assembly could constitute a satisfactory light emitting backlighting device for a liquid crystal display, having sufficient brightness to back light the LCD screen.

In addition to lack of knowledge of suitability as to brightness, it was not known at the time of making the invention of claim 70 that an LED/phosphor assembly could provide the homogeneity required for back lighting of LCD displays. Back lighting devices for an LCD screen must provide brightness uniformity and color uniformity across the full area of the LCD screen. Any inadequacy or non-uniformity of back lighting can render an LCD display product deficient or even useless for its intended purpose. It was not known at the time of making the invention that an LED/phosphor assembly could meet these requirements. See the accompanying Brandes affidavit, at paragraph 9 thereof.

Still further, it was not known at the time the invention of claim 70 was made whether the extremely long operating life of LED elements (in relation to other then-developed lighting devices)[3] would enable an LED/phosphor assembly to remain stable over such extremely long operating life and provide the high brightness uniformity and high color uniformity required for backlighting of an LCD screen. See the accompanying Brandes affidavit, at paragraph 10 thereof.

For these further reasons, claims 70 and 71 are patentably distinguished over the art.

The Brandes affidavit also introduces secondary evidence that at the time the invention was made, white light-producing single LED devices had not been developed.

Appended as Exhibit A of the Brandes affidavit is a copy of a copyright 1996 information release of Fraunhofer-Gesellschaft (http://www.thg.de/press/md-e/md1997/197), published after the presently claimed invention had been made, stating that "[S]ingle white LEDs were not feasible to date" and that "[T]he mixture of colors making up white light was only possible with a combination of three different diodes." This information release goes on to publicize Fraunhofer-Gesellschaft's "innovative idea … the generation of white light by luminescence conversion" of an LED/luminescent dye assembly, as a "breakthrough." Such information release, published after the invention of claim 70 had already been made by the present inventors Bruce Baretz and Michael A. Tischler, is further evidence of the innovative character of the claimed invention, wherein an "LED/phosphor assembly produces white light back light

[3] "..on the order of ten years or over 50,000 hours," as discussed at page 3, line 5 of the present application.

illumination for the liquid crystal display." (See the accompanying Brandes affidavit, at paragraph 12 thereof.)

The Brandes affidavit in Exhibit B thereof presents further secondary evidence, in the form of a copy of an additional information release published in 1997, entitled Fraunhofer-Gesellschaft: Research News Special 1997, published at http://www.fhg.de/press/md-e/md1997/sondert2.htm, which states that:

> "Red, yellow, and yellowgreenish [sic] emitting LEDs have already been on the market for a long time, while blue and green emitting LEDs became commercially available only three years ago. By combining red, green, and blue emitting diodes, the generation of white light became possible. However, the emission of white light by a single chip LED was still impossible.
>
> This problem was solved by a research team at the Fraunhofer-Institut fur Angewandte Festkorperphysik IAF in Freiberg (Germany) and, at the same time, by their colleagues at Nichia Chemical Industries in Japan. Their innovative idea was to generate white light by luminescence conversion. They combined a blue emitting GaN LED with an organic dye or an inorganic phosphor, emitting at longer wavelengths, to synthesise white light by additive colour mixing. ....For the invention of the single chip white emitting LED the research team at the IAF was awarded the 1997 Fraunhofer Prize."

This further information release, published after the invention of claim 70 had already been made by the present inventors Bruce Baretz and Michael A. Tischler, (1) identifies the conventional approach of combining separate red, green and blue emitting diodes to generate white light, (2) documents the prior belief in the field that single LED production of white light was "impossible," and (3) presents the achievement of white light production by a single LED in an LED/phosphor assembly as "innovative." This Fraunhofer-Gesellschaft information release, published after applicants' claimed invention was made, therefore constitutes further evidence of the innovative character of the invention claimed in claim 70. (See the accompanying Brandes affidavit, at paragraph 12 thereof.)

The foregoing provides additional evidence of the absence of any derivative basis in the teachings of the Stevenson and Seder references, or the art generally, for the applicants' claimed invention, as broadly claimed in claim 70.

It therefore is requested that the rejection of claim 70, and the rejection of claim 71 dependent from claim 70 and rejected on corresponding grounds, be withdrawn.

It is noted that all remaining claims 31, 33-36, 44, 47-48, 51-52 and 73-76 depend directly or indirectly from claim 70, and are therefore likewise patentable over the art.

All other grounds of rejection in the October 20, 2008 Office Action are now moot.

The application is therefore in form and condition for allowance.

Fee Payable for Added Claims 73-76

The addition herein of new dependent claims 73-76, in consequence of cancellation of claims herein, does not increase the number of claims beyond the number for which payment previously was made in this application.

Accordingly, no added claims fee is submitted to be due. Nonetheless, if it is determined that any additional fee or charge is properly payable for the filing and entry of this response, the same is hereby authorized to be charged to Deposit Account No. 08-3284 of Intellectual Property/Technology Law.

Additional References of Farrell and Bournay, Jr. et al Furnished at November 20, 2008 Interview

During the November 20, 2008 USPTO interview, Examiner Abul Kalam furnished the undersigned attorney with copies of Farrell U.S. Patent No. 5,143,433 ("Farrell") and Bournay, Jr. et al U.S. Patent No. 4,573,766 ("Bournay"), as additional background art.

Although each of these references describes back lighting systems, neither of these references teaches or in any way suggests the use of an LED/phosphor assembly for producing white light back light illumination of a liquid crystal display.

Farrell describes a liquid crystal display system intended for daylight viewing conditions as well as night time or dark condition viewing utilizing electronic night vision equipment. To accommodate both modes of viewing, the back lighting portion of the system utilizes primary fluorescent light sources (either serpentine fluorescent tubes or separate fluorescent light tubes positioned parallel to one another – see column 5, lines 30-35 of Farrell) and secondary low-level light sources.

For low light level operation, the primary fluorescent tubes are turned off and low-level light sources are turned on.

The low-level light sources may be either incandescent or LED sources (see column 6, lines 1-2 of Farrell). Farrell discloses that when LED low-level light sources are used, red, blue, and green lights are used for back lighting (column 6, lines 9-11), and that such red, blue, and green LED sources can be used for white color balance in the low-level back lighting.

Farrell fails to disclose or suggest any LED/phosphor assembly for back lighting. Instead, this reference teaches the use of separate red LED, blue LED, and green LED low-level light sources for back lighting, consistent with the conventional use of RGB LED arrays. Farrell fails to suggest any assembling of an LED with a phosphor to generate white light for back lighting, and Farrell therefore fails to provide any derivative basis for applicant's invention as broadly claimed in claim 70.

Bournay describes a back lighting panel for an LCD module. The back lighting panel includes LED light sources, arranged so that the panel serves as a wave guide to distribute light, so that the light in turn is diffused through the LCD display area.

Bournay discloses that the back lighting is "typically a green or blue-green light," with the light color being established by the LEDs or by the color of the piece of plastic material used to make the panel (see column 4, lines 64-67 of Bournay).

Bournay thus teaches back lighting of green or blue-green color. There is no teaching or suggestion in Bournay of utilizing an LED/phosphor assembly as a back lighting element, and

Bournay therefore fails to provide any derivative basis for applicant's claimed liquid crystal display

> "comprising a back light structure including an LED/phosphor assembly in which the LED is energizable to emit radiation and the phosphor is arranged to be impinged by radiation from the LED so that the LED/phosphor assembly produces white light back light illumination for the liquid crystal display,"

as broadly recited in amended claim 70.

For the foregoing reasons, claim 70, and claims 31, 33-36, 44, 47-48, 51-52, 71 and 73-76 dependent thereunder, are fully patentably differentiated over Farrell and Bournay.

CONCLUSION

Claims 31, 33-36, 44, 47-48, 51-52, 70-71 and 73-76 are patentably differentiated over the art, and in form and condition for allowance. It is correspondingly requested that a Notice of Allowance be issued for this application.

Respectfully submitted,

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